

Coos Bay Bridge (Conde B. McCullough Memorial Bridge)
Spanning Coos Bay on the Oregon Coast Highway
North Bend
Coos County
Oregon

HAER OR-46

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HISTORIC AMERICAN ENGINEERING RECORD

COOS BAY BRIDGE (CONDE B. McCULLOUGH MEMORIAL BRIDGE) HAER OR-46

Location: Spanning Coos Bay on the Oregon Coast Highway, at North Bend, Coos County, Oregon
UTM: North Bend, Oregon Quad. 10/401220/4808980

Date of Construction: 1934-36

Structural Type: Steel cantilever half-through truss

Engineer: Conde B. McCullough, Oregon State Highway Department

Builder: Superstructure--Virginia Bridge & Iron Company
Concrete--Northwest Roads Company
Approaches--S.S. Montague Company

Owner: Oregon Department of Transportation

Use: Vehicular and pedestrian bridge

Significance: The Coos Bay Bridge is historically significant as one of the five Depression-era PWA bridges that completed the Oregon Coast Highway. The completion of these bridges marks the dividing line between the period of relative isolation and dependence on sea transportation of Oregon's southern coastal region to its modern era of land transportation and connection with the hinterland. The Coos Bay Bridge is also representative of the innovative designs by State Bridge Engineer Conde B. McCullough, a pioneer in American concrete bridge design. The McCullough Memorial Bridge includes early examples of concrete arches constructed using Considere-type hinges. The cantilever truss design also represents McCullough's attention to aesthetics, in that the upper and lower chords were curved to complete the arch motif of the bridge. The sway bracings of the truss are also curved to give motorists the impression of driving under a series of arches as they travel over the bridge.

Project Information: Documentation of the Coos Bay Bridge is part of the Oregon Historic Bridge Recording Project, conducted during the summer of 1990 under the co-sponsorship of HABS/HAER and the Oregon Department of Transportation. Researched and written by Gary Link, HAER Historian, 1990. Edited and transmitted by Lola Bennett, HAER Historian, 1992.

Related Documentation: For more information on Conde B. McCullough, see HAER OR-54.

HISTORY

The Oregon Coast Highway was constructed piecemeal, beginning in 1914 in Clatsop County. Sections were constructed north and south from the cross-mountain roads. Limited funds dictated slow progress on these highways. In 1919 the Oregon legislature permitted a bond issue of \$2.5 million to complete the road, at that time named the Roosevelt Coast Military Highway. After World War I, the United States military establishment was concerned about defending an inaccessible coastline, and supported this bond measure. The era of long-distance automobile touring exploded in the 1920's, adding impetus to the completion of the coast highway. The road, and various small bridges, were constructed over a twenty-year period by the different counties, ultimately uniting the disparate highway sections. In 1931 Lewis A. McArthur, an Oregon geographer and historian, suggested that the name of the Roosevelt Coast Highway be changed to the Oregon Coast Highway. In 1932 roughly 400 miles of highway were completed from the Columbia River south to the California border.¹

In 1932 the highway was yet to be entirely connected. Five channels in the southern half of the state--Coos Bay, Umpqua River, Siuslaw River, Alsea Bay and Yaquina Bay--were crossed by ferries. Soon after the highway was completed, however, travel across these channels dramatically increased and it quickly became apparent that the ferries were inadequate for the traffic. The State Highway Commission called them a "barrier to the growth and development of the Oregon coast region."²

Even before completion of the highway it was assumed that these major crossings would eventually be bridged. The state contemplated constructing one bridge each year, and in May 1932 the bridge spanning the Rogue River at Gold Beach was completed. In 1931 chambers of commerce, community clubs and other residents of the central and southerly coastal areas organized the Oregon Coast Highway Association, a regional chamber of commerce. This body pressed the state highway commission to construct another bridge. But the commission had no money for another such undertaking, and felt that it would be no use trying to sell bonds to raise money as the country was in the midst of a major depression.³

On June 30 and 31, 1932, the Oregon Coast Highway Association held a meeting at Waldport to discuss plans for pushing construction of more bridges. Ex-governor A.W. Norblad proposed building three bridges as a means to create a market for lumber production in the area. Sam Dolan, an instructor in engineering at Oregon State College, suggested charging tolls on the bridges as a means to help them pay for themselves. This idea was not greeted warmly, and a debate ensued, but it was decided that with popular support tolls may be necessary. The Highway Association also decided to press the state to appeal to the Reconstruction Finance Corporation for funds. The RFC was a Hoover Administration relief program established by Congress in 1932 to help banks, railroads and other major businesses. One year after this meeting the Oregon Coast Highway Association persuaded the state highway commission to apply to the RFC for money. Just before approval, however, administrations changed in Washington, D.C. The RFC was cancelled, and an application had to be submitted to the Federal Emergency Administration of Public Works (PWA) of President Franklin Delano Roosevelt's administration. State Bridge Engineer Conde B. McCullough explained the state bridge section's role at this time: "When the opportunity of securing federal financing for the structures arose, no planning on any of the bridges except for the Alsea Bay Bridge at Waldport had been done. The force of designers was more than doubled, and a night shift organized. After six months of intensive work, plans and specifications were completed."⁴

Total estimated cost of the project was \$5,602,000. The original agreement with the PWA stipulated that the federal government would grant the state \$1,402,000, and loan the state

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\$4,200,000 through the sale of bonds. But the state decided then to sell the bonds on the open market, saving on interest rates, and the federal government agreed. Within the state, however, the question of tolls had not been resolved. Tolls were not a popular idea. It was estimated that a carload of five people would pay \$4.00 in tolls alone to drive from Coos Bay to Newport and back. Increased highway revenues gave the state new confidence to pay back the loans, and the 1935 state legislature abolished tolls on the bridges.⁵

Many coastal residents felt that the bridges should be constructed of wood to help out the lumber businesses in the region. The state highway commission considered using wood but decided it would not be practical for the region's climate. The high winds and damp salt air of the coast would cause maintenance costs to run too high, and a few of the spans would be too long for a successful wooden bridge. These structures would necessarily be constructed of steel and concrete, which would last much longer than wood. Besides, state officials argued, the amount of wood required for the wooden falsework for the construction of steel and concrete bridges would be nearly as much as if the bridges themselves were made of wood. Still, lumber interests agitated. At a highway commission meeting in Portland they pushed for the use of wood on the coastal bridges. McCullough feared that if their pressure caused delay, the federal money would go elsewhere. In addition, the federal government would not approve the use of wood for the five bridges. Regional residents also feared the loss of federal money, which for them would mean the loss of an anticipated influx of jobs and of local business that construction would bring. Local chambers of commerce voted to support the state in its plan for steel and concrete bridges. The federal government granted final approval of the plans, and in the summer of 1934 contracts were awarded for the construction of five steel and concrete coastal bridges.⁶

One purpose of the coastal bridges project as finalized was to provide jobs for people unemployed by the Great Depression. The project aggregated over 2.1 million man hours directly on the bridges. In addition to this, the project benefitted Oregon industries by consuming 16 million board feet of lumber, 54,000 cubic yards of sand, 110,000 cubic yards of gravel, and 182,000 barrels of cement. It was also expected that future revenue from tourism along the highway would increase greatly, to the benefit of both the state and the region. After construction of the bridges tourism jumped 72 percent in one year.⁷

The bridges also capped twenty-two years of Oregon Coast Highway construction. Concrete was the primary construction material, not only for its durability in the climate but also for its beauty in form. Much attention was given to appearance. The Gothic arch was the primary architectural element. These bridges represent classic examples of the Art Deco style which was a popular design style of the late 1920's and 1930's. The bridges were designed to augment and blend with the natural beauty of their surroundings. State Bridge Engineer McCullough called them "jewel-like clasps in perfect settings, linking units of a beautiful highway."⁸

DESCRIPTION

I am rather at a loss to list any unusual thing about the Coos Bay Bridge. It can be said that this structure is the longest cantilever span in Oregon. There are, however, many other cantilever spans in the United States which exceed this in length. We have always felt that the most unusual thing about the structure is the attention to appearance given in the design. The usual cantilever structure is far from a thing of beauty, but we feel that in this structure we have at least minimized the unpleasant architectural appearance of the usual cantilever spans.

G.S. Paxson, Bridge Engineer, 1941.⁹

The beauty of the bridge lies in its graceful symmetry. Its arches, steel spires, and gridwork reveal the sensitivity of its designer to historical tradition. But McCullough adapted those architectural design elements to the natural setting of Coos Bay in a uniquely harmonious way. The bridge gives pattern to space and light and to the incessant flow as naturally as the topmost branches of a Douglas fir or channels of an offshore reef.

Nathan Douthit, 1986.¹⁰

The Coos Bay Bridge, 5305' long, is the longest and most southerly of the five PWA coastal bridges, and it was also the costliest. It is a steel continuous cantilever half-through truss with bracing above and below deck. The cantilever design was adopted because high volume of shipping made a draw span undesirable. Also, the wide channel and high banks on both sides dictated a high-level bridge. The steel truss is 1708' long, with the central portion being 793' long, and the anchor portions being 457½' long each. Vertical clearance at the center is 145 feet above mean low water. The top and bottom chords of the truss are curved in outline. The sway bracing is also curved, giving the impression of a series of Gothic arches as one travels underneath on the roadway. Horizontal clearance inside the truss is 27', and vertical clearance is 16'-11". The truss includes no latticework, as minimum steel surface was desired.¹¹

Two main towers support the truss. Each of these weighs 34 tons and rises 280' above the water. Their cross sections form a Maltese cross motif. The base sections of the towers rest on 3-inch thick steel plates, called anchor shoes, which are anchored into the main piers by bolts.¹²

The bases of the two main piers (9 and 10) are 43'x90', and the distance between the two provide a main channel clearance of 515'. The upper piers rise in two shafts, 11'x18', cross-braced horizontally and diagonally. Piers 8 and 11 also consist of two shafts rising from a concrete base, cross-braced at their tops by a Gothic arch.¹³

Thirteen reinforced concrete deck arch spans with open spandrels flank the cantilever spans, seven on the north side and six on the south side. The two lengths total 2,761', with individual spans ranging from 151' to 265' in length. Reinforced concrete deck girder spans approach the arch spans. There are nine on the north end and five on the south end, totalling 835'. The roadway is 27' wide and the sidewalk on each side is 3'-6" wide. At the end of each approach there are spaces along the road for travelers to pull their cars over. Ornate concrete stairs lead down under the bridge to grassy areas below the approaches.¹⁴

CONSTRUCTION

Acting State Bridge Engineer Glen S. Paxson supervised construction of the five coastal bridges as Conde B. McCullough had taken a leave of absence to work on bridges in Central America. Raymond Archibald was the resident engineer in charge of construction at Coos Bay. He left to work on the Inter-American Highway and was replaced by Dexter R. Smith. Contracts were awarded to the Northwest Roads Company to construct the piers and concrete portions. The Virginia Bridge and Iron Company furnished the steel superstructure. The F.L. Holser Company was subcontracted to erect the steel portions and the S.S. Montague Company to construct the approaches. The PWA engineers on the site were S.M.P. Dolan and A.E. Eberhart.¹⁵

Work commenced on July 10, 1934. Two hundred fifty men were employed each week working day and night shifts with a weekly payroll of \$7,000. Common laborers earned 50 cents per hour and semi-skilled workers, 75 cents. Each man worked thirty hours per week in order to employ as many men as possible. The construction consumed five million board feet of lumber

for falsework, 51,000 cubic feet of concrete, 3,635 tons of structural steel, and 2,205 tons of reinforcing steel. 217,000 feet of piling was driven and 24,000 cubic yards of excavation was moved.¹⁶

Over 600 piles were driven for each of the two main piers (9 and 10). About one-fifth of the piles under piers 8 and 11 were battered to provide for the unbalanced load. These piers support the anchor arms and one end of the two innermost concrete arches. On the end concrete arches, the outside is on rock and the inside is on piling. Some of the piling for these inside piers is also battered.¹⁷

Each of the two main towers was shipped to the site in four sections. They were erected by means of a derrick resting on a platform adjacent to the pier. The towers were erected vertical, but later pulled out of plumb towards the anchor arms to counteract the dead load of the cantilever span.¹⁸

The erection of the truss was done by moving the derrick to the top of the pier. The soft bottom of the bay made it impractical to erect falsework the entire length of the span. One falsework bent was erected at the second panel point shoreward from the main pier, and the anchor arm was constructed to that point. The erection of the cantilever span was done at the same time as the anchor arm. However, anchor arm construction was kept slightly ahead of cantilever construction in order to keep the structure balanced on the falsework bent. When the length of the anchor arm reached 275', a second falsework bent was constructed at that point and construction progressed shoreward.¹⁹

Considered hinges were used in the construction of the concrete arches at the crown and skewbacks. This method consist of reducing a section of concrete at the hinge point, and leaving the reinforcing steel at the hinge unconnected. After the dead load was placed on the arch, the reinforcing steel was welded together and the concrete poured to make a full section of the arch. This method is employed in order to reduce the stress of putting the dead load on the arch. The second and third columns on the end of each of the arches was tied rigidly to the deck. In order to reduce the restraining action of the deck on the arch, the middle columns were given hinges, or rockers.²⁰

REPAIRS AND MAINTENANCE

The Coos Bay Bridge has required only routine maintenance in its life--painting, cleaning, pier soundings and minor repairs. However, it was forced to close for repairs in December 1986 after being struck by a ship. On December 4, 1986, the Swedish cargo ship Elgaren struck the center of the bottom chord. High tide that day was 3' above average and a malfunction on the ship made it unable to lower a projecting loading ramp in time to avoid collision. Damage to the lower portion of both lateral supports and some cross bracing had to be repaired. Local residents did not lose their humor during the inconvenience of a closed bridge. Local merchants sold tee shirts that read "Where the Ship Hits the Span."²¹

ENDNOTES

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4. "History of Coast Bridge Program is Interesting," Coos Bay Harbor (North Bend, Oregon), 28 May 1936, p.1; Miller, p.12; "Years of Planning for Coast Bridges Bear Fruit in Series of Dedications," Coos Bay Times (Marshfield and North Bend, Oregon), 1 June 1936, p.2.
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7. "Oregon Bridges Subject of Address Before AAUW," Statesman (Salem, Oregon), 21 Jan 1934; Oregon State Highway Commission, Twelfth Biennial Report, p.59; Arlene Castle, et al., Yaquina Bay, 1778-1978 (Newport: Lincoln County Historical Society, 1979), pp.54-56.
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9. G.S. Paxson, Bridge Engineer, Letter to Charles E. Wilson, Coos Bay Times, 2 October 1941, (Oregon Department of Transportation, Bridge Section Files).
10. Nathan Douthit, A Guide to Oregon South Coast History (Coos Bay: River West Books, 1986).
11. Oregon Department of Transportation, Environmental Section, Bridge File #1823, "Engineering Antiquities Survey," November 1982.
12. "Bridge Weighed Down By 'Anchor Shoes,'" Coos Bay Times, 1 June 1936, p.7; "Cantilever Erection Plan is Feature of Coos Bay Bridge," Western Construction News, July 1936, p.224.
13. A.O. Chase, "Design of the Coast Highway Bridges," Civil Engineering (October 1936), p.650.
14. Oregon Department of Transportation, Bridge Section, Bridge Log, p.17; "Engineering Antiquities Survey."

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15. "Approaches to Coos Bay Span Are Attractive," Coos Bay Times, 1 June 1936, p.7; "Coos Bay Bridge," Oregon Motorist (May 1936), p.7; ODOT, Environmental Section, Bridge File #1823, Conde B. McCullough, Letter to White & Wyckoff Manufacturing Company, 30 April 1946.

16. "Coos Bay Bridge," p.7; "Memory Still Vivid After 50 Years," North Bend News (Oregon) 7 May 1986, p.1.

17. Chase, p.648.

18. "Cantilever Erection Plan is Feature of Coos Bay Bridge," Western Construction News (July 1936), p.224.

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20. "Cantilever Erection Plan," p.226; Chase, p.648.

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ADDENDUM TO
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